Requirements Analysis of a Serious Game for Deaf Players

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Abstract. Talk Town is a serious digital game to overcome social isolation in Deaf children by combating stigma associated with hearing impairments and providing modelling of social communication skills. This paper presents the research process and outcomes to ensure that Talk Town is engaging and useful for players, educators and parents. It is described and framed using Cooper's Requirements Definition and qualitative methods. The motivation for the game-based intervention is illustrated with findings from a structured literature search and supported with insights gained from qualitative enquiries. Findings and themes from interviews and co-design activities are discussed, personas and artefacts illustrated, and relevant content, game and design recommendations for future work in this area presented.

Keywords: Serious game · Game-based intervention · Deaf and Hard of Hearing (DHH) · Requirements Definition · Design · User experience (UX)

1 Introduction

1.1 Context

Deaf and Hard of Hearing (DHH) children can face significant barriers to social communication despite the advent of sophisticated audiological technologies such as the cochlear implant providing improved access to sound [1–3].

The majority of DHH students are born to hearing parents and educated in mainstream settings where they may be the only DHH student, a situation which can have implications on the development and application of social communication [4]. Contextual barriers can compound the challenges which DHH students face, particularly when encountering stigma. Self-advocacy skills are necessary to recognize the barriers to successful interaction, find possible solutions and employ strategies for their communication needs [5, 6]. Particular challenges exist with pragmatic skills around

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expressive and receptive language [7, 8], stigma, theory of mind and executive function [2, 9, 10]. In light of these varied challenges, a serious game-based intervention was proposed to promote Deaf players' social communication skills and develop confidence related to a range of everyday social and learning activities, by modelling effective strategies in an engaging format.

2 Literature Review

2.1 Structured Literature Search

A search for relevant past work into digital game-based interventions that targeted social and pragmatic skills for DHH students was conducted, which yielded no comparable precedents to incorporate into the research and requirements definition.

A systematic literature search was therefore conducted to identify game or technology-based interventions that targeted social communication for DHH players, or for children with Autism Spectrum Disorder (ASD), with inclusion and exclusion criteria developed and published on PROSPERO [11]. The search was widened to include ASD related interventions because of the dearth of game intervention research relevant to individuals who were DHH. Though the aetiology is different, some similarities exist in terms of presentation, for example delays in Theory of Mind development compared to hearing peers. Seven databases were systematically searched to identify relevant work, with key search criteria including optimized string variants of theory of mind, self-efficacy, self-advocacy, social skills, social pragmatics, AR, VR, and Game. Once the initial screening was completed, papers identified as relevant were peer-reviewed in teams of two for their accuracy in meeting inclusion criteria. Only a small number were deemed relevant, although of these no single intervention which targeted multiple target areas was identified. This indicated that research, like the one presented in this paper, to inform an intervention in the target areas was well justified.

3 Methods/Framework

3.1 Framework and Approach

Given the multidisciplinary nature of the challenge, an approach that combined Cooper's Requirements Definition [12], Grounded Theory Methods [13, 14] and human-centred Co-Design principles [15] was determined most suitable for the research.

The pre-discovery phase comprised of preliminary observational work in context, interviews with stakeholders and reviewing existing research. Questions to guide the content and structure of workshops and interviews were iterated based on this process.

3.2 Design and Qualitative Methods

Artefacts for co-design workshops and interview scripts for semi-structured interviews [16, 17] were developed following the 'pre-discovery' phase, and both research

activities piloted with test participants. Particularly for interviewing Deaf respondents, it was crucial to pilot the interview sessions to ensure communication and the interview environment was as clear as possible.

In the co-design workshops, an adapted focus group format [18] was created that incorporated a segment for group discussion, followed by an active ideation component utilising 10 prompt resources inspired by human-centred design tools developed by IDEO [15]. Participants were encouraged to write their ideas on Post-Its (Fig. 1), allowing the researchers to ask follow-up questions relating to their motivations and thinking behind the contributions, as well as to record ideas for the purpose of later study. Results were collated in summary transcripts from each session and coded, tables produced for all visual data, and full transcripts of interviews were prepared.

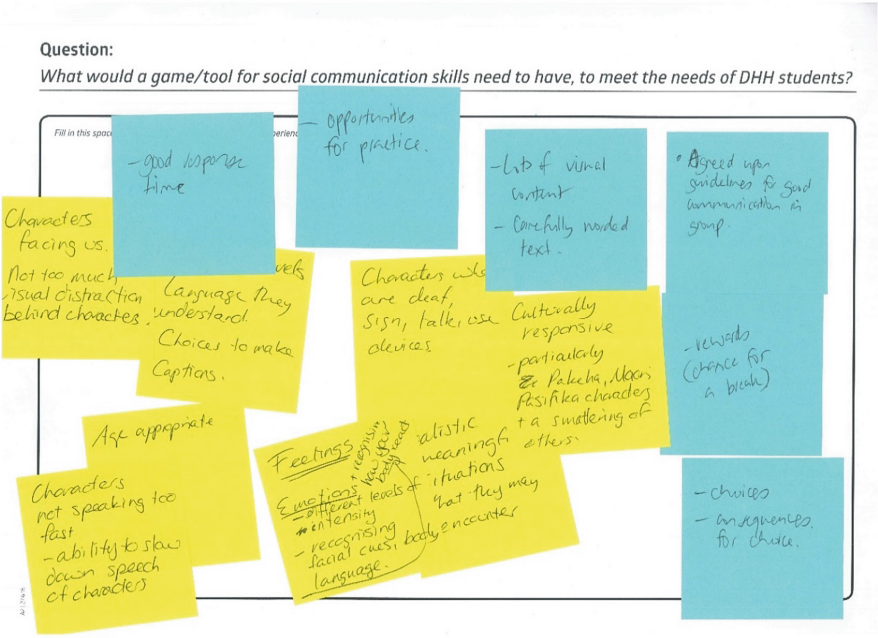

Fig. 1. Co-design resource developed for ideation sessions with Educators and Specialists

3.3 Respondents and Session Structure

Specialists, educators, and parents contributed to the research with their involvement in interviews and focus groups. Overall, 17 respondents participated in the primary research. Three focus groups and 7 interviews with subject matter experts were carried out. Interviews were conducted remotely via video conferencing tools, to allow respondents more flexibility in participation throughout the country. Four Deaf education specialists who were Deaf themselves contributed, adding another layer of experience to the data.

Personas and Scenarios

To guide the design and development efforts, personas and scenarios (Fig. 2) were developed based on the data collected in interviews and co-design workshops [12]. An unintended outcome was learning that education specialists had used cases for the personas, and they described the artefacts as helpful for their practice. Personas and scenarios were designed iteratively in collaboration with a member of the Deaf education community who was a Speech Language Therapist, and whose involvement served as an additional point of triangulation [19].

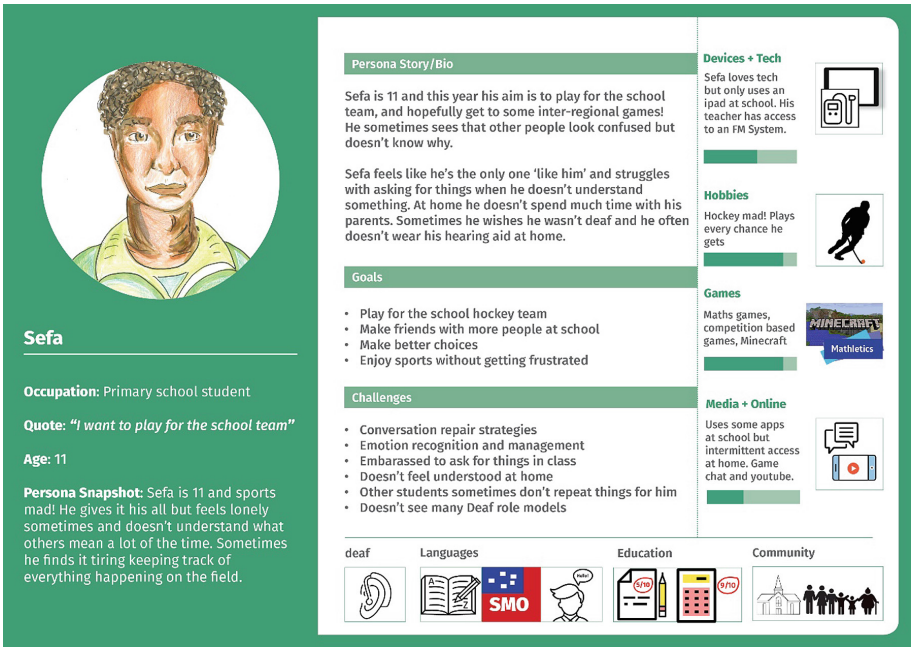

Fig. 2. Sefa, the primary persona, created based on primary and secondary data [20]

3.4 Analysis Framework

Thematic content analysis was used to interpret qualitative data and transform it into insights, findings and themes [20, 21]. Codes were developed following transcription, where ideas discussed by respondents were described by labels that communicated the essence of the phrases being coded. Memoing, member checking, and peer review of a sample of the coded transcripts and negative cases were supporting methods employed to limit impact of bias and arrive at validated themes [22–24].

4 Findings

4.1 Areas of Social and Pragmatic Skills

Social and pragmatic skills encompass themes relating to communication and their deployment in social settings. Many recurring phrases and examples were discussed by parents and educators. The importance of contextual barriers, self-efficacy and advocacy, theory of mind, conversational repair and vocabulary were among the most prominent themes.

"Contextual barriers and scene inspiration" was a combined code used to describe examples that were given about environments, interactions and scenarios which DHH children found challenging. Examples included parties, sports environments, playing with others, and times of transition between schools and from school to work or university. Existing strategies to support social communication formed recommendations for the game 'scenes', to serve as game contexts in which skills could be modelled that would feel authentic for players, as well as being useful for educators.

Vocabulary access and its associated impact on conversational repair was found to be important, reiterating what had been discovered previously [7, 8]. Without access to the language skills necessary to effectively communicate and advocate for oneself, it is hard to make the leap from recognizing a problem to taking steps to solve for it. Teachers also discussed the concept of scaffolding, where knowledge is built on the students' existing level of knowledge and skills before progressing to more complex content. There are clear parallels between scaffolding as an effective learning strategy and engaging gameplay.

Self-efficacy and self-advocacy were often described together by respondents or used interchangeably. This may suggest that one needs self-efficacy skills as a precursor to utilizing these for self-advocacy purposes [25–28].

The areas of social communication and pragmatics formed the core focus of the intervention, with contextual barriers informing the scenarios displayed in the game.

These are scenarios that require effective strategies for responding to contextual barriers, such as navigating a noisy environment where the player character's vision is blocked, reducing their capacity to recognise facial cues of characters in the scene. The player is asked to choose from a range of options how to respond, which promotes both self-efficacy by offering player choice and advocacy by modelling how one may speak up for their needs in a challenging environment.

4.2 Games and Play

Games and play concerned the areas perceived important in a game-based intervention so that it would be engaging for DHH players. Themes included existing games played by students, play-based activities employed by teachers, user experience elements of games, levels and progression, game mechanics and reinforcement. Recommendations included: provision of choice to reinforce the concept that players had influence on outcomes, high visual contrast for legibility, and progression to motivate players and provide a feeling of accomplishment and reinforcement. The context of play was also important – educators described how they would play games with their students, and

use these to provoke conversations and additional learning beyond the game. Resource teachers of the Deaf (RTD) may be uniquely placed to augment this learning, as they have more one-to-one contact time directly with the student. RTDs are specialists that have a caseload of DHH children they work closely with, and often develop or configure activities to augment and reinforce learning. For this reason, a secondary persona of an RTD was created to aid the design of the intervention in this area (see Fig. 3).

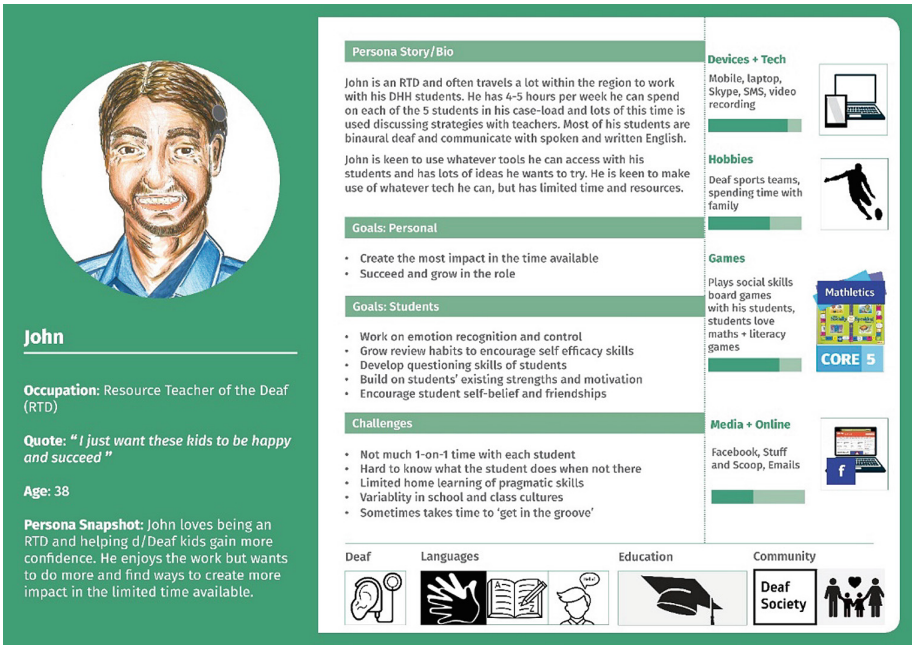

Fig. 3. John, a secondary persona representing a resource Teacher of the Deaf

4.3 Identity, Culture and Relationships

Identity, culture, and relationships related to themes of Deaf identity, relationships with hearing peers, stigma, identity, friendships and culture.

A strong sense of Deaf culture was discussed by respondents as being a protective factor for individuals to counteract stigma relating to hearing loss. Other codes were related to cultural dimensions of deafness, for example, what it means to be "Māori and Deaf" (respondent comment from Focus group 3). A recommendation for the intervention was to promote positive Deaf identity through characters from a range of backgrounds and to depict a range of audiological devices, enabling players to self-select their device and identity.

4.4 Discussion and Recommendations

The areas that emerged from the analysis informed the recommendations for the game-based intervention. The core areas assumed to be important for the intervention were validated, and many others emerged through this research enquiry have been incorporated in the development of the intervention.

A plethora of potential scenes for the game, based on the lived expertise of respondents were suggested, coupled with educational best practices and observations forming the user experience and design recommendations. There is an evidential lack of a comparable, digital resource for DHH students. The game-based intervention described and the recommendations made based on insights from domain specialists can serve to inform and guide related future work in the area.

5 Conclusion and Future Work

A mixed approach to design discovery for a serious game that combines a requirements definition framework, co-design principles, and qualitative methods was illustrated. Findings indicated that there is a lack of available resources in this area, that the proposed game-based intervention is needed, and that initial problem areas are validated in addition to several others identified. Relevant game and user experience areas were outlined.

Future work should investigate efficacy and fidelity of the intervention, as well as how this can be used most effectively in collaboration between educators and students to reinforce in-game learning. There are also opportunities to involve mainstream educators and students more deeply in future research and to play-test the intervention with DHH students. Involving more mainstream educators in research enquiries of this nature is worthwhile, as this is where the majority of DHH students are educated, and it appears promising to examine the challenges within these settings in a more comprehensive manner in the future.

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